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硕　士　学　位　论　文

可植入式微器件中若干技术的研究

Investigation of Some Technologies in Implantable Micro Devices

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摘 要

随着 MEMS 技术的迅速发展，许多种微型器件被研究开发以用于生物医学领域。可植入式微器件是目前 MEMS 技术应用于医学领域的一个前沿课题。本文主要研究了可植入式器件中的若干问题，包括三个部分：

第一部分：一种用于可植入微型射频 MEMS 电感线圈的研究

首先分析了硅衬底上电感模型及影响其品质因数的各个因素，在此基础上研究玻璃衬底上的微型射频 MEMS 电感线圈，运用 HFSS 软件进行优化设计，确定了制作工艺，完成了器件的微制造并进行了测试。

第二部分：可植入式器件封装技术的研究

在对可植入式器件的要求、性质进行分析的基础上，研究了可植入式器件的封装技术。然后以微型射频 MEMS 电感线圈作为样品分别使用两种方法：金属封装法与复合 Si_xN_y-SiO_2-Si_xN_y 介质薄膜和有机硅胶连用的封装法对其进行封装，对封装好的样品在模拟人体环境的生理盐水中进行了测试。测试结果表明，使用复合介质薄膜和有机硅胶进行封装具有更好的性能，能使微器件在植入环境中长期工作。

第三部分：可植入式信号发射系统的初步研究

在分析了可植入式信号发射与接收系统的工作要求的基础上对其信号发射与接收电路进行了分析，接着研究了一种脉冲振荡器芯片，结果表明：这个脉冲振荡器芯片能够满足可植入式信号发射系统的要求。

关键词：可植入式器件；MEMS ；电感线圈 ；封装技术

Abstract

With the rapid development of MEMS technology during the past 20 years, many micro devices have been developed and used in the biomedical engineering. The implantable device is a cutting-edge topic which is a MEMS technology application used in the medical field. Several technical issues of the implantable device were studied in this paper which mainly includes three parts:

Part I: Study of an implantable micro RF MEMS inductive coil

First, the inductance model on the silicon substrate and factors which impact the quality factor of the inductive coil were analyzed. Based on that, the micro RF MEMS inductive coil on the glass substrate was studied. The HFSS software was used to optimize the design of the coil and determine the production process. The microfabrication and test of the device were completed.

Part II: Study of the packaging technology for implantable microdevices

Based on the analysis of the requirement and performance of the implantable device, the packaging technology was studied. Two packaging methods were developed by using the implantable micro RF MEMS inductive coil as the sample. The first method used metal to package and the second one used the Si_xN_y-SiO_2-Si_xN_y dielectric thin film and organic silicone simultaneously. And then the two packaged devices were tested by being put into the saline which was similar to the human body environment. The result shows that the device which was packaged by Si_xN_y-SiO_2-Si_xN_y dielectric thin films and organic silicone has better performance and longer working hours in implanted environment.

Part III: Preliminary study of the signal emitting system for implantable microdevices

The circuits of the implantable signal emitting and receiving system were analyzed based on the working requirement analysis. And then an implantable pulse oscillator chip was studied. The result shows that the pulse oscillator implantable chip can meet the requirement of the implantable signal emitting system.

Keywords：Implantable devices; MEMS; Inductor coil; Package technology

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